REMARKS

Forty-nine claims were originally filed in this case, and all claims were rejected. Claims 1, 6, 12, 22, and 36 have been amended. Reconsideration of the application in view of the above changes and the following remarks is respectfully requested.

Provisional Claim Rejections - 35 USC § 101

In item 2 of the Office Action, the Examiner provisionally rejected claims 1-21 under 35 U.S.C. § 101 as claiming the same invention as that of claims 1-21 of co-pending Application No. 08/777,557. As the conflicting claims have not been patented, this is a provisional double patenting rejection. Applicants respectfully submit that the above claim amendments in the present case when considered and compared to the claims amendments made in the first amendment filed in co-pending Application No. 08/777,557 clarify that the present application is directed to a different invention from co-pending Application No. 08/777,557. In the event that the co-pending application issues before the present case and the Examiner disagrees with the Applicants' position, the Applicants will file a terminal disclaimer to overcome such a rejection.

Claim Rejections - 35 USC § 103

In item 4 of the Office Action, the Examiner rejected claims 1-21 under 35 U.S.C. § 103(a) as being unpatentable over Accad (U.S. Patent No. 5,553,200). In response, the Applicants have amended claims 1, 6, 12, 22, and 36. To aid in clarifying the manners in which amendments to the aforementioned claims serve to differentiate the

Applicants' invention over Accad, a brief overview of Accad and the Applicants' invention is provided.

A) Accad's Teachings

Accad teaches a method and apparatus for providing bit-reduced versions of image data, and performing image data reconstruction, using dither arrays. With respect to bit-rate reduction operations, Accad begins with an image data array I(i, j) that is gamma corrected to form an array I'(i, j). Accad reads data within I'(i, j) on a pixel-by-pixel basis to determine quantization or coding intervals, such that each pixel falls between or within a coding interval t(d) and t(d+1). Thus, for each pixel, Accad determines a coding index d. Accad further teaches the generation of an array I"(i, j), which contains a normalized offset value relative to the coding index d for each pixel.

Accad then employs conventional halftoning or dithering techniques to code each pixel such that it is assigned to an interval corresponding to index d, or an interval corresponding to index (d+1). As stated in column 12, lines 56 through 60: "...a pixel in the interval of index d is assigned a code equal to d, the index of the interval it is in, or (d+1), the index of the interval it is in incremented by one, the assignment depending on the result of the halftone technique."

Accad's teachings relative to the manners in which such dithering operations may be performed are limited to conventional value- or magnitude-comparision dithering, wherein each value within the normalized offset array I"(i, j) is compared with a dither value that resides within a conventional threshold or dither array T(k, l). For a given value within the

normalized offset array I", if the normalized offset value is less than the dither value against which it is being compared, the corresponding pixel is assigned a coded or dithered value C(i, j) = d; otherwise, the pixel is assigned a dithered value C(i, j) = (d+1). Accad provides details of the foregoing operations in column 13, lines 22-36.

Accad further teaches the use of a modified threshold array, for the purpose of speeding up the thresholding comparison operations, i.e., those operations that Accad specifically associates with determining whether I" < T, as recited in column 13, line 37 through column 14, line 15. Regardless of any technique that Accad teaches or suggests to reduce the time required to perform the dithering, Accad's teachings are limited to conventional value- or magnitude-comparison dithering operations, i.e., operations directed to determining whether I" < T.

B) Applicants' Invention

In the Applicants' invention, a pixel representing a particular color and having a given number of bits is truncated, thereby forming an approximate color signal and a fractional signal FRAC. Based upon its binary value, FRAC is mapped to a particular bit pattern or sequence. Examplary bit patterns are shown in Figure 5. Alternatively, one or more bit patterns may be more abstracted sequences, such as described on page 19, lines 11-15.

A dither value stored in a lookup table and associated with the pixel's address is subsequently mapped to a particular bit position within the bit pattern. Based upon the binary value associated with this bit position, the invention selects and outputs either the approximate color signal, or an incremented approximate color signal.

The Applicants' invention provides for probabilistic dithering rather than simply performing conventional "value < threshold" dithering. For example, consider an eight-bit value 01010010, which is truncated to give 01010 as an approximate color signal and 010 as a FRAC signal. FRAC could then be mapped to a bit pattern such as 11000000, as shown in Figure 5.

A value within a dither array is mapped to a given bit position within the bit pattern. That is, a dither array value between 0 and 7 may be respectively mapped to a correspoding bit position 0 through 7 in the bit pattern. The binary value present at the bit position to which the dither value is mapped determines whether the approximate color signal or an incremented approximate color signal is output.

In the above example, if the dither array value is between 0 and 5, the values in the corresponding bit positions equal 0, and the approximate color signal (01010) would be selected. If the dither array value is either 6 or 7, the values within the corresponding bit positions equal 1, and the incremented approximate color signal (01011) would be selected.

This means that unless the dither array value falls within the upper 6/8 of its possible range of values, the approximate color signal is selected. Alternatively, this can be viewed as meaning that on average, the approximate color signal is selected 5/8, or 62.5%, of the time, while the incremented approximate color signal is selected 2/8, or 25%, of the time. Analogous considerations apply to FRAC values and bit patterns other than that considered in this example.

The Applicants' invention thus provides probabilistic, that is, percentage- or pattern-filtered, dithering, which Accad neither teaches nor suggests. Relative to the example above with an approximate color signal of 01010 and a truncated portion 010, Accad would

essentially teach only a comparison between a dither value and the binary value 010. Thus, Accad's determinations of whether I"(i, j) < T(k, l) are not equivalent to nor suggestive of the Applicants' dithering system and method.

Claim Amendments

Claim 1 as amended now recites the following:

1. (Amended) A method for dithering color in a graphics system that displays a group of pixels and wherein the color of the pixels is represented by color shades having fewer than eight bits, comprising the steps of:

(a) generating an eight bit color shade value for each pixel representing a desired color for each pixel;

(b) truncating the desired eight bit color shade value to obtain a truncated color shade value;

(c) generating a FRAC value for each pixel from the truncated bits of said eight bit color shade value;

(d) producing a ramp value for each pixel using said FRAC value, wherein said ramp value encodes a discrepancy between the desired eight bit color shade value and the truncated color shade value; [and]

(e) mapping a dither value to a bit position within said ramp value; and

(f) using a bit from said ramp value to select a color shade value of fewer than eight bits that determines the color of each pixel.

In item 4 the Office Action on page 3, the Examiner stated that Accad does not teach the selection of one bit in the ramp value to determine the color shade of less than eight bits

for each pixel. In turn, the Applicants have amended claim 1 to include the step of mapping a dither value to a bit position within the ramp value.

The Examiner additionally stated that Accad's I"(i, j) value is functionally equivalent to the claimed FRAC and ramp value, the only difference being that Accad's values are expressed as normalized decimals. The Applicants respectfully assert that in view of the above discussions, Accad's dithering via determining whether I"(i, j) < T(k, l) is neither functionally equivalent to, nor suggestive of, the claimed FRAC and ramp values. The Applicants further submit that the Examiner's asserted functional equivalence does not exist regardless of whether Accad employs binary or normalized decimal values.

The Applicants respectfully submit that claim 1 as amended is nonobvious in view of Accad. As claims 2-5 are dependent upon claim 1, the Applicants respectfully request that the Examiner withdraw the rejection of claims 1-5 under 35 U.S.C. § 103.

Claim 6 as amended recites the following:

6. (Amended) A method for dithering pixel color in a graphics system that displays a group of pixels in which primary pixel colors are represented by color shades having fewer than eight bits comprising the steps of:

(a) generating an eight bit color shade value for each pixel representing a desired color for each pixel;

(b) truncating the desired eight bit color shade value to produce a first color shade value comprising fewer than eight bits;

(c) generating a FRAC value for each pixel representing the truncated bits of said desired eight bit color shade value;

(d) producing a ramp value for each pixel using said FRAC value, wherein said ramp value encodes a discrepancy between the desired eight bit color shade value and the first color shade value;

(e) producing an addend value for incrementing said first color shade value,

(f) incrementing said first color shade value by said addend value to produce a second color shade value; [and]

(g) mapping a dither value to a bit position within said ramp value; and

(h) selecting said first color shade value or said second color shade value to determine the color of each pixel in said group of pixels.

Claim 6 as amended includes the step of mapping a dither value to a bit position within the ramp value, which is not taught or suggested by Accad. The Applicants respectfully submit that claim 6 as amended, as well as claims 7-11, which depend upon claim 6, are nonobvious in view of Accad. The Applicants further request that the Examiner withdraw the rejection of claims 6-11 under 35 U.S.C. § 103.

Claim 12 as amended recites the following:

12. (Amended) A graphics system that displays color shades based upon binary representation having fewer than eight bits, wherein said graphics system initially receives a desired eight bit binary representation for each color shade that is used by the graphics system to render pixels in a pixel grid, said desired eight bit binary representation including upper order bits and lower order bits, comprising:

select fractional logic that receives the desired eight bit binary representation and wherein said select fractional logic produces on its output lines the lower order bits of said desired eight bit binary representation value;

a look-up table that produces a control value based upon an address of each pixel; [and]

ramp probability logic coupled to said select fractional logic [and said look-up table], said ramp probability logic producing a ramp value that encodes a discrepancy between said desired eight bit binary representation and said binary

representations having fewer than eight bits[.] and

mapping logic coupled to said look-up table and ramp probability logic, said mapping logic mapping a look-up table value to a bit position within said ramp value.

Claim 12 as amended includes logic for mapping a look-up table value to a bit position within the ramp value, which is neither taught nor suggested by Accad. The Applicants respectfully submit that claim 12, as well as its dependent claims 13-21, are nonobvious in view of Accad, and request that the Examiner withdraw the rejection of these claims under 35 U.S.C. § 103.

Claim 22 as amended recites the following:

22. (Amended) A computer readable storage medium for storing an executable set of software instructions which, when inserted into a host computer system, is capable of controlling the operation of the host computer, said software instructions being operable to dither pixel colors in a graphics system and wherein the color of the pixels is represented by color values having fewer than eight bits, said software instructions including:

means for determining a first index value to a look-up table;

means for providing a look-up table value from said look-up table based on said first index value;

means for determining a ramp probability value; [and]

means for mapping said look-up table value to a bit position within said ramp probability value; and

means for [using said ramp probability value and said look-up table value to determine] selecting a dither color value in said graphics system.

Claim 22 as amended specifies means for mapping a look-up table value to a bit position within the ramp probability value, which is neither taught nor suggested by Accad. The Applicants submit that claim 22, as well as its dependent claims 23-35, are nonobvious in view of Accad, and request withdrawal of the rejection of claims 22-35 under 35 U.S.C. § 103.

Claim 36 as amended recites the following:

36. (Amended) A method for dithering color in a graphics system that displays a group of pixels on a screen, wherein the color of the pixels is represented by color values having fewer than eight bits, said method comprising:

determining a first index value to a look-up table;

determining a look-up table value from said look-up table based on said first index value;

determining a ramp probability value <u>that encodes a discrepancy between an eight-bit color value and a color value having fewer than eight bits</u>; [and]

<u>mapping said look-up table value to a bit position within the ramp probability value; and</u>

using [said ramp probability value and said look-up table value to] <u>a value stored in said bit position</u> determine a dither color value in said graphics system.

Claim 36 as amended includes the step of mapping a look-up table value to a bit position within the ramp probability value. Claim 36 as amended further specifies using a value stored in this bit position to determine a dither color value. The steps in claim 36 as amended are neither taught nor suggested by Accad. The Applicants submit that claim 36 as amended is nonobvious in view of Accad, and respectfully request that the Examiner

withdraw the rejection of claim 36, as well as its dependent claims 37-49, under 35 U.S.C. § 103.

The Applicants respectfully request a two-month extension of time in responding to the above-identified office action and has also enclosed a check for the requisite fee for the two-month extension of time in responding to the above-identified office action.

In view of the foregoing arguments and amendments, Applicants respectfully submit that the claims presently in this case are now in condition for allowance. Reconsideration and prompt favorable action are therefore solicited.

Respectfully submitted,
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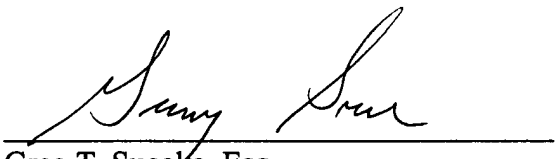
By: 

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